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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/654,845	09/01/2000	Jifa Hao	87552.99R272/SE-1528PD	6844

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EXAMINER	
NADAV, ORI	

ART UNIT	PAPER NUMBER
2811	

DATE MAILED: 03/11/2005

Please find below and/or attached an Office communication concerning this application or proceeding.

H·A

Office Action Summary	Application No.	Applicant(s)	
	09/654,845	HAO ET AL.	
	Examiner	Art Unit	
	ori nadav	2811	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *24 January 2005*.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-8,10-15 and 17-34* is/are pending in the application.

4a) Of the above claim(s) *18-34* is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-8,10-15 and 17* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☐ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____.
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: _____.

DETAILED ACTION

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

Claims 1-8, 10-15 and 17 are rejected under 35 U.S.C. 103(a) as being unpatentable over Tokura et al. (5,545,908) in view of Schlangenotto et al. (5,063,428) and Schlangenotto et al. (5,773,858, cited by applicant).

Regarding claim 1, Tokura et al. teach in figure 1 and related text a power semiconductor device having high avalanche capability, the device comprising: a semiconductor substrate with two surfaces and an N+ doped layer 1 extending into the substrate from one surface thereof, an N- doped layer 2 over the N+ doped layer, a P doped well 14 formed in the N- doped layer and extending from the other surface of the substrate into the N- doped layer, a P+ doped region 10 formed in the - doped well and also extending from the other surface of the substrate into the P doped well, the P doped well defining an upwardly curving junction between the P doped well and the N- doped layer, said upwardly curving junction extending from the lower end of the P doped well to the other surface of the substrate and an N+ doped region (the N+ region which is located away from the P doped well 8) formed in the other surface of the substrate and in the N- doped layer (the N+ doped region is formed in a P doped well, and the P doped well is formed in the N- doped layer. Therefore, the N+ doped region

is formed in the N- doped layer), said N+ doped region laterally spaced from the P+ doped region and the P doped well.

Tokura et al. do not teach the thickness of the P+ doped region and the P doped well, and recombination centers comprising noble metal impurities disposed substantially in the N - doped layer and P doped well.

Although figure 1 of Tokura et al. does not depict "P-" semiconductor layer, the P doped well 14 can be held as a "P-" semiconductor layer, because P- concentration is a low relative concentration, and the concentration of the P doped well 14 is also a low relative concentration with respect to the P+ doped region 10.

Regarding the claimed limitations of P- doped 2a and P+ doped 2b layers having a combined thickness of about 5 microns to about 12 microns, Schlangenotto et al. (5,063,428) teach that the P- doped 2a and P+ doped 2b layers have a doping curve similar to that of figure 4 (column 7, lines 3-5). Schlangenotto et al. (5,063,428) further teach P+ doped layer 2b having a thickness of 0.2 microns (column 5, lines 33-35), wherein P- doped layer 2a should have a thickness greater than 5 microns and less than 70 microns (column 5, line 65 to column 6, line 3). It would have been obvious to a person of ordinary skill in the art at the time the invention was made to use P- doped 2a and P+ doped 2b layers having a combined thickness of about 5 microns to about 12 microns, in the device of Tokura et al. in order to form a device as small as possible within the criteria limits of Schlangenotto et al. (5,063,428). Note that at the time the claimed invention was made the size of semiconductor devices has been dramatically minimized.

Regarding the claimed limitations of forming recombination centers comprising noble metal impurities disposed substantially in the N - doped and P- doped layers, Schlangenotto et al. (5,063,428) teach that it is known in the art to form recombination centers comprising noble metal impurities in power diodes in order to reduce charge carrier life (column 1, lines 24-29). Schlangenotto et al. (5,063,428) further teach forming recombination centers in the power diode of figure 3 in order to improve the characteristics of the device (column 5, lines 39-46).

Schlangenotto et al. (5,773,858) teach that it is known to form recombination centers in high speed power diodes in order to improve the dynamic characteristics by lowering the charge carrier life (column 1, lines 21-25).

Schlangenotto et al. (5,063,428) and Schlangenotto et al. (5,773,858) do not limit the location of the recombination centers to specific areas of the power diodes. Therefore, it is understood to an artisan that the recombination centers are formed throughout the power diodes.

It would have been obvious to a person of ordinary skill in the art at the time the invention was made to form recombination centers comprising noble metal impurities in the device of Tokura et al. in order to order to improve the dynamic characteristics of the device by lowering the charge carrier life by a well known method. The combination is motivated by the teachings of Schlangenotto et al. (5,063,428) and Schlangenotto et al. (5,773,858) who point out the advantages of forming recombination centers in power diodes. Note that the broad recitation of the claim does not require the recombination centers to be located only in the N - doped and P- doped layers.

Regarding the claimed limitations of a power semiconductor device having high avalanche capability, this feature is inherent in prior art's device, because prior art's device comprises recombination centers, and the avalanche capability is a function of the recombination centers, such as the location and density of the recombination centers. Furthermore, the recitation of a power semiconductor device having high avalanche capability occurs in the preamble. A preamble is generally not accorded any patentable weight where it merely recites the purpose of a process or the intended use of a structure, and where the body of the claim does not depend on the preamble for completeness but, instead, the process steps or structural limitations are able to stand alone. See *In re Hirao*, 535 F.2d 67, 190 USPQ 15 (CCPA 1976) and *Kropa v. Robie*, 187 F.2d 150, 152, 88 USPQ 478, 481 (CCPA 1951).

Regarding claims 2 and 3, Tokura et al. do not teach a P- doped well having a thickness of about 4 microns to about 10 microns and P+ doped region having a thickness of about 0.1 to about 2 microns. Schlangenotto et al. (5,063,428) teach P+ doped layer 2b having a thickness of about 0.1 to about 2 microns (column 5, lines 33-35). It would have been obvious to a person of ordinary skill in the art at the time the invention was made to use P- doped well having a thickness of about 4 microns to about 10 microns and P+ doped region having a thickness of about 0.1 to about 2 microns in the device of Tokura et al. in order to form a device as small as possible within the criteria design limits.

Regarding claims 4-7, Tokura et al. do not teach a P- doped well has a dopant level of at least 10E16 atoms/cm3 and a dopant level of about 2.5x 10E17 atoms/cm3 and a P+ doped region having a dopant level of about 6x10E19 atoms/cm3, respectively. It would have been obvious to a person of ordinary skill in the art at the time the invention was made to form a P- doped well having a dopant level of about 2.5x 10E17 atoms/cm3 and a P+ doped region having a dopant level of about 6x10E19 atoms/cm3 in prior art's device, since forming a P- doped well having a dopant level of about 2.5x 10E17 atoms/cm3 is within the skills of an artisan, subject to routine experimentation and optimization. Note that differences in concentration or temperature do not support the patentability of subject matter encompassed by the prior art unless there is evidence indicating such concentration or temperature is critical. "[W]here the general conditions of a claim are disclosed in the prior art, it is not inventive to discover the optimum or workable ranges by routine experimentation." In re Aller , 220 F.2d 454, 105 USPQ 233, 235 (CCPA 1955). See also In re Hoeschele , 406 F.2d 1403, 160 USPQ 809 (CCPA 1969). For more recent cases applying this principle, see Merck & Co. Inc . v. Biocraft Laboratories Inc. , 874 F.2d 804, 10 USPQ2d 1843 (Fed. Cir.), cert. denied , 493 U.S. 975 (1989), and In re Kulling , 897 F.2d 1147, 14 USPQ2d 1056 (Fed. Cir. 1990).

Regarding claim 8, it would have been obvious to a person of ordinary skill in the art at the time the invention was made to form an N- doped layer having a dopant level of about 10E14 atoms/cm3 to about 10E15 atoms/cm3 in prior art's device since forming

an N -doped layer having a dopant level of about 10E14 atoms/cm3 to about 10E15 atoms/cm3 is within the skills of an artisan, subject to routine experimentation and optimization.

Regarding claims 10-11, Schlangenotto et al. (5,063,428) teach noble metal impurities comprise platinum (column 1, lines 26-27).

Regarding the process limitations recited in claim 12 ("recombination centers are formed by platinum diffusion through the N + doped substrate"), these would not carry patentable weight in this claim drawn to a structure, because distinct structure is not necessarily produced. Note that a "product by process" claim is directed to the product per se, no matter how actually made, In re Hirao, 190 USPQ 15 at 17 (footnote 3). See also In re Brown, 173 USPQ 685; In re Luck, 177 USPQ 523; In re Fessmann, 180 USPQ 324; In re Avery, 186 USPQ 161; In re Wertheim, 191 USPQ 90 (209 USPQ 554 does not deal with this issue); and In re Marosi et al., 218 USPQ 289, all of which make it clear that it is the patentability of the final product per se which must be determined in a "product by process" claim, and not the patentability of the process, and that an old or obvious product produced by a new method is not patentable as a product, whether claimed in □product by process□ claims or not. Note that the applicant has the burden of proof in such cases, as the above case law makes clear.

Regarding claims 13-14, prior art does not teach platinum impurities at a concentration of about 1x10E15 to about 1x10E16 atoms/cm3, and about 2x1015 atoms/cm3. It would have been obvious to a person of ordinary skill in the art at the time the invention was made to form platinum impurities at a concentration of about 1x10E15 to about 1x10E16 atoms/cm3, and about 2x1015 atoms/cm3 in prior art's device, in order to adjust the device characteristics according to the requirements of the application in hand, since the reverse current and the device performance depend on the platinum impurities concentration.

Regarding claims 15 and 17, Tokura et al. teach in figure 1 using a diode in a MOSFET or an IGBT power device, wherein an N+ doped region 7 disposed in an N -doped layer 2, adjacent P+ 10 and P- 8 doped layers.

Response to Arguments

Applicant argues that Tokura et al. do not teach an N+ doped region formed in the N- doped layer, because the N+ doped region is formed in a P doped well, and the examiner ignores the presence of the P doped well.

The examiner does not ignore the presence of the P doped well. The examiner explained that since the N+ region is formed in a P doped well, and the P doped well is formed in the N- doped layer, then the N+ doped region is formed in the N- doped layer. If applicant wants to claim a device wherein the N+ region is formed in the N- doped

layer without the presence of the P doped well, applicant can recites the limitation of an N+ region being formed in the N- doped layer without having a P region or a PN junction there between.

Papers related to this application may be submitted to Technology center (TC) 2800 by facsimile transmission. Papers should be faxed to TC 2800 via the TC 2800 Fax center located in Crystal Plaza 4, room 4-C23. The faxing of such papers must conform with the notice published in the Official Gazette, 1096 OG 30 (November 15, 1989). The Group 2811 Fax Center number is (703) 308-7722 and 308-7724. The Group 2811 Fax Center is to be used only for papers related to Group 2811 applications.

Any inquiry concerning this communication or any earlier communication from the Examiner should be directed to *Examiner Nadav* whose telephone number is **(571) 272-1660**. The Examiner is in the Office generally between the hours of 7 AM to 4 PM (Eastern Standard Time) Monday through Friday.

Any inquiry of a general nature or relating to the status of this application should be directed to the **Technology Center Receptionists** whose telephone number is **308-0956**

Ori Nadav
March 7, 2005

ORI NADAV
PRIMARY EXAMINER
TECHNOLOGY CENTER 2800